

Claims

- [c1] A cap structure for a magnetic random access memory (MRAM) device, comprising:
 - a cap layer formed over a magnetic tunnel junction (MTJ) stack layer;
 - an etch stop layer formed over said first cap layer; and
 - a hardmask layer formed over said etch stop layer;wherein said etch stop layer is selected from a material such that an etch chemistry used for removing said hardmask layer has selectivity against etching said etch stop layer material.
- [c2] The cap structure of claim 1, wherein said etch stop layer comprises a nonmagnetic, electrically conductive material.
- [c3] The cap structure of claim 2, wherein said etch stop layer further comprises at least one of: aluminum, copper, platinum, manganese platinum, iridium, iridium manganese, chromium, chromium molybdenum and ruthenium.
- [c4] The cap structure of claim 2, wherein said etch stop layer is removable using an oxygen based etch chemistry.

- [c5] The cap structure of claim 2, wherein:
said etch stop layer is selected to be corrosion resistant with respect to halogen based etch chemistries; and
said etch stop layer is further selected to be resistant to post-etch, aqueous cleaning processes.
- [c6] The cap structure of claim 2, wherein said cap layer further comprises at least one of: tantalum, tantalum nitride and titanium nitride.
- [c7] The cap structure of claim 2, wherein said hardmask layer further comprises at least one of: tantalum, tantalum nitride and titanium nitride.
- [c8] A cap structure for a magnetic random access memory (MRAM) device, comprising:
a first cap layer formed over a magnetic tunnel junction (MTJ) stack layer;
an etch stop layer formed over said first cap layer;
a second cap layer formed over said etch stop layer; and
a hardmask layer formed over said etch stop layer;
wherein said etch stop layer is selected from a material such that an etch chemistry used for removing both said hardmask layer and said second cap layer has selectivity against etching said etch stop layer material.
- [c9] The cap structure of claim 8, wherein said etch stop layer

comprises a nonmagnetic, electrically conductive material.

- [c10] The cap structure of claim 9, wherein said etch stop layer further comprises at least one of: aluminum, copper, platinum, manganese platinum, iridium, iridium manganese, chromium, chromium molybdenum and ruthenium.
- [c11] The cap structure of claim 9, wherein said etch stop layer is removable using an oxygen based etch chemistry.
- [c12] The cap structure of claim 9, wherein:
said etch stop layer is selected to be corrosion resistant with respect to halogen based etch chemistries; and
said etch stop layer is further selected to be resistant to post-etch, aqueous cleaning processes.
- [c13] The cap structure of claim 9, wherein said cap layer further comprises at least one of: tantalum, tantalum nitride and titanium nitride.
- [c14] The cap structure of claim 9, wherein said hardmask layer further comprises at least one of: tantalum, tantalum nitride and titanium nitride.
- [c15] A method for opening a hardmask layer of a magnetic random access memory (MRAM) device, the method

comprising:

patterning a photoresist layer formed over the hardmask layer;

implementing a first etch process to remove exposed portions of the hardmask layer, said first etch process terminating on an etch stop layer formed over a first cap layer, said first cap layer in turn formed over a magnetic tunnel junction (MTJ) stack layer;

removing said etch stop layer formed over said first cap layer; and

implementing a second etch process to remove exposed portions of said first cap layer, said etch process terminating on an upper magnetic layer of said MTJ stack layer.

- [c16] The method of claim 15, wherein said etch stop layer is a nonmagnetic, electrically conductive material comprising at least one of: aluminum, copper, platinum, manganese platinum, iridium, iridium manganese, chromium, chromium molybdenum and ruthenium.
- [c17] The method of claim 16, wherein said etch stop layer is removed with an oxygen based etch chemistry.
- [c18] The method of claim 16, wherein said first etch process further used to remove a second cap layer formed between said etch stop layer and the hardmask layer.

[c19] The method of claim 18, wherein said first and second cap layers further comprises at least one of: tantalum, tantalum nitride and titanium nitride.

[c20] The method of claim 15, further comprising:
implementing at least one of a deionized water and an acid based aqueous solution rinse following said first etch process; and
implementing at least one of a deionized water and an acid based aqueous solution rinse following said removing said etch stop layer.